FORM PTO-1390
(REV. 5-93)

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER
4634/0K253US0

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)

10/069037

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/ZA00/00136	August 16, 2000	August 16, 1999

TITLE OF INVENTION

METALLURGICAL THERMOCOUPLE

APPLICANT(S) FOR DO/EO/US

Adrian Lionel GRAY

Applicant herewith submits to the United States Designated/Elected office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.

2. [] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S. C. 371.

3. [] This is an express request to begin national examination procedures (35 U.S.C. 371 (f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S. C. 371 (b) and PCT Articles 22 and 39 (1).

4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. [X] A copy of the International Application as filed (35 U.S. C. 371 (c) (2))
   a. [] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [X] has been transmitted by the International Bureau
   c. [] is not required, as the application was filed in the United States Receiving Office (RO/US)

6. [] A translation of the International Application into English (35 U.S. C. 371 (c)2)).

7. [] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. [] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [] have been transmitted by the International Bureau.
   c. [] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [] have not been made and will not be made.

8. [] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c) (3)).

9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).

10. [] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. [X] An Information Disclosure Statement under 37 CFR 1.97 and 1.98 (with 7 references).

12. [X] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. [X] A FIRST preliminary amendment.
    [] A SECOND or SUBSEQUENT preliminary amendment.

14. [] A substitute specification.

15. [] A change of power of attorney an/or address letter.

16. [] Other items or information:

EXPRESS MAIL CERTIFICATE
2/15/02 Label No. EV039137720US
Date
I hereby certify that, on the date indicated above, this paper or fee was deposited with the U.S. Postal Service & that it was addressed for delivery to the Assistant Commissioner for Patents, Washington, DC 20231 by "Express Mail Post Office to Addressee" service.

D B Park
Name (Print)

Signature

U.S. APPLICATION NO. (if known, see 37 C.F.R. 1.5) 10/069037	INTERNATIONAL APPLICATION NO.: PCT/ZA00/00136	Attorney's Docket Number 4634/0K253US0

17. [x] The following fees are submitted:		CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492 (a)(1)-(5)): Search Report has been prepared by the EPO [X] or JPO []	$890.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482)	$710.00		
No international preliminary examination fee paid to USPTO(37 CFR 4.482) but international search fee paid to USPTO (37 CFR 1.445 (a) (2)...	$740.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....	$1,040.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)....	$100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =		$890.00	
Surcharge of $130.00 for furnishing the oath or declaration later than []20 []30 months from the earliest claimed priority date (37 CFR 1.492(e)).		$	

Claims	Number Filed	Number Extra	Rate		
Total Claims	20-20		X $18.00	$00	
Independent Claims	2-3		X $84.00	$.00	
Multiple dependent claims(s) (if applicable)		+280		$	
			TOTAL OF ABOVE CALCULATIONS =	$890.00	
Reduction by 1/2 for filing by small entity, if applicable.				$445.00	
			SUBTOTAL =	$.00	
Processing fee of **$130.00** for furnishing the English translation later the [] 20 [] 39 months from the earliest claimed priority date (37 CFR 1.492(f)).			+	$	
			TOTAL NATIONAL FEE =	$.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). the assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property			+	$40.00	
			TOTAL FEES ENCLOSED =	$485.00	
				Amount to be: refunded	$
				charged:	$

a. [X] A check in the amount of $485.00 to cover the above fees is enclosed.

b. [] Please charge my Deposit Account No.04-0100 in the amount of $ to cover the above fees.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 04-0100. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Darby & Darby P.C.
805 Third Avenue
New York, New York 10022-7513

SIGNATURE Joseph B. Lerch by John C. Jolan

NAME JOSEPH B. LERCH

REGISTRATION NO.26,936 Reg No. 36,036

EXPRESS MAIL CERTIFICATE

Date 2/15/02 Label No. EV039137720US

I hereby certify that, on the date indicated this paper or fee was deposited with the U.S. Postal Service and that it was addressed for delivery to the Assistant Commissioner of Patents & Trademarks, Washington, DC 20231 by "Express Mail Post Office to Addressee" service.

D Beck D Beck

Name (Print) Signature

File No: 4634/0K253US0

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Adrian Lionel GRAY

Serial No: T/B/A (U.S. National Phase of PCT/ZA00/00136, filed August 16, 2000)

Filed: Concurrently Herewith

For: METALLURGICAL THERMOCOUPLE

PRELIMINARY AMENDMENT

Hon. Commissioner of
Patents and Trademarks
Washington, DC 20231

Attn.: Box PCT, RO/US

Sir:

Prior to examination, Applicants wish to amend the above-identified application as follows.

IN THE CLAIMS

Please delete claim 17 and amend claims 5, 7-10 and 12-15 as follows:

5. (Amended) A thermocouple as claimed in claim 1 in which refractory material includes particulate borosilicate and boric acid powder.

7. (Amended) A thermocouple as claimed in claim 5 in which the boric acid comprises about 3% to 5% weight of the refractory material.

8. (Amended) A thermocouple as claimed in claim 5 in which the boric acid content of the refractory material is about one half of the borosilicate content.

9. (Amended) A thermocouple as claimed in claim 2 in which the tubes of the sheath are stainless steel.

10. (Amended) A thermocouple as claimed in claim 2 in which the refractory material is predried at a temperature of between 135°and 150°C.

12. (Amended) A thermocouple as claimed in claim 2 in which the refractory material is beaded before being formed into the sheath.

13. (Amended) A thermocouple as claimed in claim 1 in which the tip is formed from a thermocouple cable with a negative metal tube housing a positive wire embedded in a low temperature sintering material.

14. (Amended) A thermocouple as claimed in claim 1 in which the tip is formed by providing a hot junction from the wires of the thermocouple cable and supported by a sheath as above defined with both tubes and the refractory formed to cap the hot junction.

15. (Amended) A thermocouple as claimed in claim 2 in which the outer tube of the sheath is annealed after the constriction process and the refractory material at least partially sintered during the annealing process.

Please add the following new claims 18-21:

18. A thermocouple as claimed in claim 2 in which refractory material includes particulate borosilicate and boric acid powder.

19. A thermocouple as claimed in claim 6 in which the boric acid comprises about 3% to 5% weight of the refractory material.

20. A thermocouple as claimed in claim 6 in which the boric acid content of the refractory material is about one half of the borosilicate content.

21. A thermocouple as claimed in claim 7 in which the boric acid content of the refractory material is about one half of the borosilicate content.

REMARKS

The claims are amended for the purpose of eliminating multiple claim dependencies.

A marked-up version of the claims, which indicates all amendments made, is submitted herewith.

None of the amendments introduces new matter.

An early and favorable examination is earnestly solicited.

Respectfully submitted,

John C. Polanin Reg. No. 36,036
for Joseph B. Lerch

Joseph B. Lerch
Reg. No. 26,936
Attorney for Applicant

Date: February 15, 2002

DARBY & DARBY P.C.
805 Third Avenue
New York, NY 10022
212-527-7700

File No: 4634/0K253US0

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Adrian Lionel GRAY

Serial No: T/B/A (U.S. National Phase of PCT/ZA00/00136, filed August 16, 2000)

Filed: Concurrently Herewith

For: METALLURGICAL THERMOCOUPLE

MARK UP TO PRELIMINARY AMENDMENT

Hon. Commissioner of
Patents and Trademarks
Washington, DC 20231

Attn.: Box PCT, RO/US

Sir:

Prior to examination, Applicants wish to amend the above-identified application as follows.

IN THE CLAIMS

Please delete claim 17 and amend claims 5, 7-10 and 12-15 as follows:

5. (Amended) A thermocouple as claimed in [any one of the preceding claims] claim 1 in which refractory material includes particulate borosilicate and boric acid powder.

7. (Amended) A thermocouple as claimed in [claims 5 or 6] claim 5 in which the boric acid comprises about 3% to 5% weight of the refractory material.

8. (Amended) A thermocouple as claimed in [any one of claims 5 to 7] claim 5 in which the boric acid content of the refractory material is about one half of the borosilicate content.

9. (Amended) A thermocouple as claimed in [any one of claims 2 to 8] claim 2 in which the tubes of the sheath are stainless steel.

10. (Amended) A thermocouple as claimed in [any one of claims 2 to 9] claim 2 in which the refractory material is predried at a temperature of between 135°and 150°C.

12. (Amended) A thermocouple as claimed in [any one of claims 2 to 11] claim 2 in which the refractory material is beaded before being formed into the sheath.

13. (Amended) A thermocouple as claimed in [any one of the preceding claims]

claim 1 in which the tip is formed from a thermocouple cable with a negative metal tube housing a positive wire embedded in a low temperature sintering material [as defined in any one of claims 4 to 7 above].

14. (Amended) A thermocouple as claimed in [any of the preceding claim 1 to 12] claim 1 in which the tip is formed by providing a hot junction from the wires of the thermocouple cable and supported by a sheath as above defined with both tubes and the refractory formed to cap the hot junction.

15. (Amended) A thermocouple as claimed in [any one of claims 2 to 14] claim 2 in which the outer tube of the sheath is annealed after the constriction process and the refractory material at least partially sintered during the annealing process.

[17. A thermocouple substantially as described and illustrated in Fig. 1 of Fig. 2 of the accompanying drawings.]

Please add the following new claims 18-21:

18. A thermocouple as claimed in claim 2 in which refractory material includes particulate borosilicate and boric acid powder.

19. A thermocouple as claimed in claim 6 in which the boric acid comprises about

3% to 5% weight of the refractory material.

20. A thermocouple as claimed in claim 6 in which the boric acid content of the refractory material is about one half of the borosilicate content.

21. A thermocouple as claimed in claim 7 in which the boric acid content of the refractory material is about one half of the borosilicate content.

METALLURGICAL THERMOCOUPLE

FIELD OF THE INVENTION

This invention relates to thermocouples and more particularly to thermocouples for use in determining the temperature of molten metals.

BACKGROUND TO THE INVENTION

Many kinds of thermocouples have been designed and used for use in the metallurgical industry. In general in the melting and casting processes for the production of primary and secondary aluminium the use of so called "Marshall Tip Thermocouple" has become fairly standard practice. In the baking process of carbon anodes for the production of aluminium the use of wire and bead or mineral insulated thermocouples protected by suitable metallic sheaths has become the norm.

In the ferrous metal industry platinum rhodium type thermocouples are used because the temperatures of molten steel are generally greater than those at which some of the components of the thermocouple used in the non-ferrous industry melt. It is difficult to provide insulation of the platinum rhodium element at molten steel temperatures for any length of time and insulation which will enable repeated use of the thermocouple is also difficult to provide. Consequently in the interests of economy, the thermocouple for this industry has been designed to protect the thermoelement for a maximum of about 4 seconds of immersion time, which is sufficient to obtain a single measurement.

Such thermocouples incorporate the smallest amount of the required materials, and where practical, the lowest cost materials in order to render the device expendable after only a single immersion into molten iron or steel.

Thus with an overriding cost consideration different thermocouples have been developed to meet the particular requirements of particular applications.

There remains however the basic requirements for all thermocouples which is the integrity of the temperature measurement obtained. To achieve this it is necessary that the measuring probe be protected against electrical conductivity of its immediate protection material and further that a barrier of sufficient mechanical strength be provided against the inherently corrosive attack from the in situ environment in which the thermocouple is to be used.

OBJECT OF THE INVENTION

As stated the kind of thermocouple used in any application is driven by cost effectiveness. All of the thermocouples referred to suffer some or other disadvantage as a result of cost and it is the object of the present invention to provide a thermocouple which with minor modification can be used in the ferrous and non-ferrous industries and which can be made at a high cost effectiveness.

SUMMARY OF THE INVENTION

According to this invention there is provided a thermocouple comprising a sensing tip and electrical connection with a mineral insulated thermocouple cable characterised in that the shielding is provided by a low temperature sintering refractory material.

Further features of this invention provide for the thermocouple cable to be types K and N for non-ferrous metals or type W, W3, W5 and molybdenum rhenium for ferrous metals.

Still further features of this invention provide for the shielding to be in the form of a sheath having inner and outer metal tubes over a filler of low temperature sintering refractory material and for the tubes to be drawn down, swaged or rolled to compact the filler between them and for a conventional binder material

to be added to the refractory material to give it the required green strength when the refractory material is beaded before introduction between the tubes.

The invention also provides for the refractory material to include particulate borosilicate and boric acid powder, for the borosilicate to comprise between 6% by weight of the total refractory material, for the boric acid to comprise about 3% to 5% by weight of the total refractory material and for the boric acid content of the refractory material to be about one half that of the borosilicate content.

Still further features of this invention provide for the inner and outer tubes of the sheath to be of stainless steel.

The invention provides a method of shielding a thermocouple comprising locating beads of suitably bound refractory material between an inner metal tube and an outer metal tube and reducing the sheath down to a predetermined size by drawing swaging or rolling during which process the beaded refractory material is compacted between the inner tube and the outer tube.

A further feature of this method provides for the reduced sheath to be subsequently annealed and the refractory material to be at least partially sintered simultaneously with the annealing of the sheath.

Yet further features of this invention provide for the tip to be provided by the dissimilar metal wires of the mineral insulated thermocouple cables providing a hot junction for the thermocouple with the wires embedded in magnesium oxide and this latter supported by a sheath as above defined or by a tube of the same metal as one wire of the cable housing the other wire of the cable to form the thermocouple tip with the wire embedded in a low sintering refractory material.

It is to be understood that where reference is made to metal tubes or wires of thermocouple cable materials being negative and positive Type K or Type W metals this polarity may be reversed. Further the terms "shield" and "shielding" are used to signify both thermal and electrical insulation.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of this invention is described below with reference to the accompanying drawing in which

FIG 1 is an oblique view of one form of thermocouple; and

FIG 2 is a section through the tip of an alternative form of thermocouple.

DETAILED DESCRIPTION WITH REFERENCE TO THE DRAWINGS

As illustrated the thermocouple (1) is made from a length of conventional mineral insulated thermocouple cable (2). This comprises an outer casing (3) of stainless steel around a magnesium oxide insulating body (4). The thermocouple is a Type K thermocouple connected to an operating tip (5) having the negative wire welded to a negative Type K tube (6) which extends around the extended Type K positive wire (7). A low temperature sintering refractory material (8) is packed in the tube (6) around the wire (7).

As mentioned above the Type K tube may form the positive connection and the wire the negative connection for the thermocouple tip.

The connection between the mineral insulated thermocouple cable (2) and the thermocouple tip (5) is located within a suitable metallic oversleeve (8) having further low sintering refractory insulation (9) around the cable (2) and tip (5) and within the oversleeve (8).

To provide sufficient physical strength as well as further insulation a sheath (10) having inner and outer tubes (11) and (12) is provided. The annular space between tubes (11) and (12) is first packed with beaded low temperature sintering refractory (13). The outer tube is then drawn down over the refractory material crushing the beads to reduce the porosity and also increasing the physical green strength of the sheath.

The outer tube may be annealed after the drawing operation and the refractory material at least partially sintered during this annealing process. It has been found advantageous to pre-dry the refractory material before use to a temperature of between 135°and 150°C.

This material may be sintered during in situ use but is preferably at least partially presintered by heating before use and maintained under conditions mitigating the ingress of moisture.

It has been found that a very suitable refractory material can be obtained by the addition of crushed borosilicate and boric acid powder in a proportion by weight of about 2 to 1 to any refractory material. Preferably the borosilicate will comprise between 6% and 10% of the weight of the composite refractory material, most preferably about 8%. The applicant has found that this mixture precipitates a reaction at only ± 780° C which is very similar to that of conventional sintering in which the surface of the aggregate particles soften and the particles fuse together to form a more dense mass. It is assumed that the borosilicate, which has a melting point of about 780° C, provides the soft surface on each particle, but only in the presence of boric acid. Once formed, it no longer melts at the same temperature. The result is a dense body that does not lose its bond even at temperatures in excess of 1000°C.

Once sintered, the ingress of atmospheric moisture, which must occur because it is still porous, appears to have no effect on the electrical conductivity of such a body. This is a decided advantage in the manufacture of thermocouples where the electrical insulation of conductors at elevated temperatures has always represented a significant problem.

This thermocouple responds instantly when immersed into molten metal, or any electrically conductive compound which bridges the two conductor ends. This provides temperature measurement of liquids as well as for solids to be obtained with the same thermocouple.

It will be appreciated that the thermocouple can be made in an acceptably cost effective manner.

The thermocouple above described is that which will be used for non-ferrous metals. For ferrous metals the Type W or molybdenum rhenium thermocouple cable and tip will be used.

Fig 2 illustrates an alternative form of thermocouple.

In this form the hot junction (15) is formed by baring the ends of the wires (16) (17) of the thermocouple and fitting a cap (18) over this junction. The end of the cable is inserted through the sheath (19) which has its end shaped to close together to form an outer cap (20) from the outer tube, a continuous layer of low temperature sintering refractory material and the closed inner tube.

This thermocouple may be satisfactorily used where instantaneous temperatures are not necessary and they can be used to obtain continuous temperature measurements. Even should the outer tube become eroded shielding is still afforded by the sintered refractory material.

Thermocouples for both ferrous and non-ferrous material can thus be provided with a high degree of shielding for both instantaneous and continuous temperature recordings.

AMENDED CLAIMS

[received by the International Bureau on 7 February 2001 (07.02.01); original claim 1-17 replaced by amended claims 1-16; (2 pages)]

1. A thermocouple comprising a sensing tip in electrical connection with a mineral insulated thermocouple cable characterised in that additional external shielding is provided by a low temperature sintering refractory material including particulate borosilicate and boric acid powder.

2. A thermocouple as claimed in claim 1 characterised in that the shielding is in the form of a sheath having inner and outer metal tubes constricted over a filler of low temperature sintering refractory material.

3. A thermocouple as claimed in claim 2 in which the outer tube is mechanically constricted to compact the filler.

4. A thermocouple as claimed in claim 3 in which the constriction is effected by drawing, swaging or rolling.

5. A thermocouple as claimed in claim 1 in which the borosilicate comprises between 6% and 10% by weight of the refractory material.

6. A thermocouple as claimed in claim 5 in which the boric acid comprises about 3% to 5% by weight of the refractory material.

7. A thermocouple as claimed in claim 5 or 6 in which the boric acid content of the refractory material is about one half of the borosilicate content.

8. A thermocouple as claimed in any one of claims 2 to 7 in which the tubes of the sheath are stainless steel.

9. A thermocouple as claimed in any one of claims 2 to 8 in which the refractory material is predried at a temperature of between 135° and 150°C.

10. A thermocouple as claimed in claim 9 in which the refractory material is at least partially sintered before the thermocouple is used.

11. A thermocouple as claimed in any one of claims 2 to 10 in which the refractory material is beaded before being formed into the sheath.

12. A thermocouple as claimed in any one of the preceding claims in which the tip is formed from a thermocouple cable with a negative metal tube housing a positive wire embedded in a low temperature sintering material as defined in any one of claims 4 to 7 above.

13. A thermocouple as claimed in any of the preceding claims 1 to 11 in which the tip is formed by providing a hot junction from the wires of the thermocouple cable and supported by a sheath as above defined with both tubes and the refractory formed to cap the hot junction.

14. A thermocouple as claimed in any one of claims 2 to 13 in which the outer tube of the sheath is annealed after the constriction process and the refractory material at least partially sintered during the annealing process.

15. A method of shielding a thermocouple comprising locating beads of suitably bound refractory material between an inner metal tube and an outer metal tube and reducing the sheath down to a predetermined size by drawing swaging or rolling during which process the beaded refractory material is compacted between the inner tube and the outer tube.

16. A thermocouple substantially as described and illustrated in Fig 1 or Fig 2 of the accompanying drawings.

FIG 1

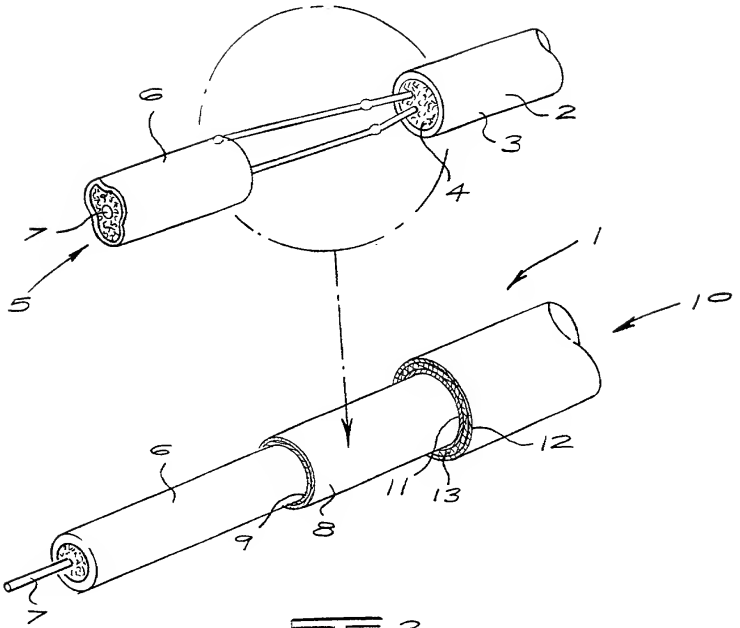
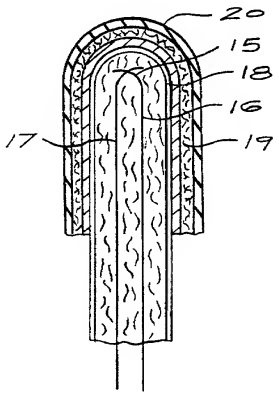


FIG 2



APPLICATION FOR UNITED STATES PATENT

DECLARATION FOR PATENT APPLICATION

As below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name.
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on

(1) the invention entitled **METALLURGICAL THERMOCOUPLE**

the specification of which

(2) (file no.)

(3) is attached hereto.

(4) was filed on as Application Serial No.

(5) and was amended on (if applicable)

Use this portion only	(6)	was filed as PCT international application
if you are entering	(7)	Number **PCT/ZA00/00136**
the U.S. National	(8)	on **16 AUGUST 2000**
phase based on a	(9)	and was amended under PCT Article 19
PCT International	(10)	on (if applicable)
Application		
Designating the U.S.		

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me which is material to patentability in accordance with Title 37, Code of Federal Regulations, s 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code s 119 of any foreign application (s) for patent or inventor's certificate listed below and have also identified below any foreign application (s) for patent or inventor's certificate or any PCT international application (s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date earlier than that of the application (s) on which priority is claimed:

(12) **Prior (Foreign) Application (s) any Priority Claims under 35 U.S.C. 119:**			**Priority Claimed:**	
ZA	**99/5203**	**16/08/1999**	**XXX**	
(Country)	(Number)	(Day/Month/Year)	YES	NO
(Country)	(Number)	(Day/Month/Year)	YES	NO
(Country)	(Number)	(Day/Month/Year)	YES	NO

TO BE USED ONLY FOR CONTINUING APPLICATION

Do not use this portion to identify a PCT application if the present application is the U.S. National phase of that PCT application	I hereby claim the benefit under Title 35, United States Code, 120 of any United States application (s) or PCT international application (s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application (s) in the manner provided by the first paragraph of Title 35, United States Code, s 112, I knowledge the duty to disclose to the United States Patent & Trademark office all information known to me as to be material to patentability as defined in Title 37, Code of Federal Regulation, s 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

(U.S. Application Number)	(U.S. Filing Date)	Status (patented,pending,abandoned)
(U.S. Application Number)	(U.S. Filing Date)	Status (patented,pending,abandoned

I hereby appoint the following partners of the firm of DARBY & DARBY as my attorneys of record with full power of substitution and revocation to prosecture this application and to transact all business in the Patent and Trademark Office:

I hereby appoint as principal attorneys: Morris Relson, (15,108), Gordon D. Copelein, (19,165), William F. Dudine, Jr. (20,569), Michael J. Sweedler, (19,937), David R. Francescani, (25,159), S. Peter Ludwig, (25,351), Joseph B. Lerch, (26,934).

ALL CORRESPONDENCE IN CONNECTION WITH THIS APPLICATION SHOULD BE SENT TO:

DARBY & DARBY P.C.
805 Third Avenue
NEW YORK, NY 10022-7513
UNITED STATES OF AMERICA

I hereby declare that all statements made herein of my own knowledge are true and that all statements made o information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

*14a	Typewritten full Name of Sole or First Inventor	ADRIAN	L	GRAY
		Given Name	Middle Initial	Family Name
*15a	Inventor's Signature	Maria L Gray		
*16a	Date of Signature	07	January	2002
		Day	Month	Year
*17a	Residence	Richards Bay, Kwa-Zulu Natal	Republic of South Africa	ZAX
		City	State or Province	Country

*18a Citizenship SOUTH AFRICAN

Post office address

*19a (Insert complete mailing address including country) 42 Ceramic Curve, Alton, Richards Bay, Kwa-Zulu Natal
Republic of South Africa

*14b Typewritten full Name of Sole or First Inventor _____ Given Name Middle Initial Family Name

*15b Inventor's Signature _____

*16b Date of Signature _____

*17b Residence _____ City State or Province Country

*18b Citizenship _____

Post office address

*19b (Insert complete mailing address including country)_____

*14c Typewritten full Name of Sole or First Inventor _____ Given Name Middle Initial Family Name

*15c Inventor's Signature _____

*16c Date of Signature _____

*17c Residence _____ City State or Province Country

*18c Citizenship _____

Post office address

*19c (Insert complete mailing address including country)_____

* **Note to Inventor:** **Please sign name on line 15 exactly as it appears in line 14 and insert the actual date of signing on line 16. If there are more inventors please add a copy of this page for identification and signatures of the additional inventors.**